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POLLUTION OF THE DETROIT RIVER, MICHIGAN WATERS OF LAKE ERIE, AND THEIR TRIBUTARIES. SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

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Report on Pollution of the Detroit River, Michigan Waters of Lake Erie, and their Tributaries

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

1. Water-Pollution
2. Lake Erie
3. Detroit River

by
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FIGURE I-I

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CONCLUSIONS

Every day more than 1.6 billion gallons of waste water flow into the Detroit River -- 1.1 billion gallons from industry and 540 million gallons from municipal sewage. Huge quantities of waste products contained in this discharge change the Detroit River from a basically clean body of water at its head to a polluted one in its lower reaches. These waters are polluted bacteriologically, chemically, physically, and biologically, and contain excessive coliform densities as well as excessive quantities of phenols, iron, oil, ammonia, suspended solids, settleable solids, chlorides, nitrogen compounds, and phosphates. Pollution of the Detroit River will become progressively worse unless effective action is taken immediately.

The City of Detroit's main sewage treatment plant, serving more than 90 percent of the people in the Project area, contributes 95 percent of the municipal waste to the Detroit River and is also the major source of suspended solids, phenols, oil, inorganic nitrogen, phosphates, and biochemical oxygen demand in the river. Overflow from combined sewers in Detroit and its suburbs, carrying both stormwater and raw sewage, contributes greatly to the degradation of the river.

In the upper Detroit River, the Great Lakes Steel Co. and the Allied Chemical Corp. are the major sources of industrial wastes. The Ford Motor Co. is the principal contributor of inorganic wastes to the Rouge River, and the Scott Paper Co. is the principal contributor of organic wastes. Downriver industries contributing significant quantities of wastes are the Great Lakes Steel Corp., the McLouth Steel Corporation, Pennsalt Chemical Corporation, and Wyandotte Chemical Corporation. On the Raisin River the leading polluters are the two Consolidated Paper Company mills, Monroe Paper Products Company, and the Union Bag-Camp Paper Company.

Other significant sources of pollution in the study area are overflows from combined sewers, municipal and industrial waste spills, and wastes from shorefront homes.

Pollution of the Detroit River causes interference with municipal water supply, recreation, fish and wildlife propragation, and navigation. Two municipal water intakes, particularly that of Wyandotte, are endangered by the high bacterial counts of the river, and the rising chloride levels indicate potential future problems for industrial water usage. In addition, high concentrations of phenols and ammonia at the Wyandotte water intake have interfered with municipal water treatment by causing taste and odor problems and reducing the effectiveness of chlorination. Excessive quantities of chlorine are needed to reduce bacteria to a safe level.

All forms of water contact sports in the lower Detroit River are hazardous. Declining levels of dissolved oxygen in the lower Detroit River as it enters Lake Erie are approaching the danger point, indicating

trouble in the future unless appropriate remedial action is taken. Together with bottom sludge deposits, oils, and toxic materials, they threaten fish, migratory birds, and other wildlife. In order to maintain navigation, extensive annual dredging is required at the junction of the Detroit and Rouge Rivers and at the mouths of the Detroit and Raisin Rivers to remove deposits of suspended solids in large part originating in municipal and industrial waste discharges.

About 6 million pounds of waste products are discharge every day from U.S. industries and municipalities to the Detroit River. 20 million pounds of measured waste constituents are discharged every day from U.S. waters of the Detroit River to Michigan waters of Lake Erie. The Raisin River, grossly polluted at its mouth, also pollutes the Michigan waters of Lake Erie.

The Michigan waters of Lake Erie have two major zones of pollution -- one in the vicinity of the mouth of the Detroit River, and one near the mouth of the Raisin River.

Bacteriological densities in the Lake from the mouth of the Detroit River to a point 2 or 3 miles south make the water unfit for recreational use; following heavy rainfall in the Detroit area, this zone is extended southward to Stony Point. The periodic contamination of Sterling State Park beaches, which are posted as unsafe for swimming, is caused by wastes from the Raisin River and septic tank drainage.

Concentrations of chlorides, metals toxic to fish life in minute concentrations, and suspended solids in the Lake portend future problems in various water uses. Composition of bottom organisms in the Detroit River changes from a pollution-sensitive population typically found in clean waters to a predominantly pollution-tolerant population in the lower River.

Pollution-stimulated algae growths have forced Monroe to move its water intake point to avoid unpleasant tastes and odors in the water, and algae blooms near the new intake again threaten to degrade Monroe's drinking water. Discharges of nutrients and organic wastes into the Michigan part of Lake Erie have speeded the enrichment of that portion of the Lake.

Water at Sterling State Park is erratically polluted, and this area occasionally had coliform counts exceeding 100,000 organisms per 100 ml. A standard frequently accepted as safe for recreation is 1,000 per 100 ml, and the recommendations in this report are based on that standard. The Raisin River was discovered to be the primary cause of this pollution; when Lake currents are northerly (40 to 45% of the time), polluted Raisin River water is carried directly to the beaches. When currents are southerly, polluted drainage from septic tanks reaches the Park. To improve water quality at Sterling State Park, these sources of pollution must be controlled.

Adverse effects of stormwater overflow on water quality were seen in all the waters studied by the Project. During and after heavy rainfall, sewage plants must bypass untreated wastes directly to the rivers, and this can occur on 33 to 45 days a year. The overflows averaged 8.2 hours and have lasted as long as 24 hours, and the detrimental effects from a single storm have lasted as long as 5 days. Bacteria in storm overflows often approached the densities found in raw sewage, with counts as high as 100 million per 100 ml. Storm-caused overflows alone are responsible for the discharge of 5 billion gallons of raw sewage to the Detroit River yearly.

While there is some evidence that water quality is improving, because of increased water uses damages are increasing, and unless remedial action is taken immediately the usefulness of the water resources of the Detroit area may be destroyed completely by pollution.

All municipal sewage treatment plants in the area currently practice primary treatment followed by chlorination. In order to protect water uses, municipal treatment facilities are to be provided capable of producing an effluent not to exceed:

1. Suspended solids concentration of 35 mg/l
2. Settleable solids concentration of 5 mg/l
3. Ammonia concentration of 2 mg/l
4. Phenol concentration of 20 µg/l
5. Oil concentration of 15 mg/l
6. Biochemical oxygen demand of 20 mg/l
7. Bacterial densities, monthly geometric mean, of 5000/100 ml.

It is recommended that all municipalities provide a minimum of secondary treatment plus adequate chlorination to maintain these standards.

Recommendations for abating pollution interfering with water use in the Detroit River and Michigan Lake Erie are made in two categories: general recommendations relating to the Project area, and specific improvements required at each waste source contributing to the polluted condition of the waters. In addition to these recommendations designed to abate existing pollution, the report points out many areas where additional improvement in water quality will aid in the prevention of future problems.

INTRODUCTION

A water pollution investigation of the Detroit River and the Michigan waters of Lake Erie has been made by personnel of the Detroit River-Lake Erie Project of the Public Health Service, U.S. Department of Health, Education, and Welfare, under the authority of Section 8 of the Federal Water Pollution Control Act as amended (33 U.S.C. 466 et seq) and at the request of the conferees of the Federal-State conference on water pollution held in Detroit, Michigan, on March 27 and 28, 1962.

The investigation was conducted to fill the gaps in existing technical information on water quality, sources and quantities of wastes, and the extent of pollution in the United States waters of the Detroit River and the Michigan waters of Lake Erie. The investigation was conducted in cooperation with the State regulatory agencies. The valuable assistance and special participation of personnel of the Michigan Water Resources Commission and Michigan Department of Health is recognized. Assistance was also rendered by the Corps of Engineers, U.S. Geological Survey, and the International Joint Commission.

Intensive surveys were made of 6 municipal and 42 industrial waste sources to ascertain their individual contributions to the waste loadings in the waters under study. These surveys were joint efforts of the Project and the appropriate State regulatory agency. In the area of industrial waste surveys, Michigan Water Resources Commission personnel collected the samples and, after analysis by the Project, the Commission evaluated the findings and made recommendations where appropriate. In some cases the Project personnel made additional recommendations.

A cooperative study was undertaken with the Michigan Department of Health and the Michigan Water Resources Commission to determine and compare the characteristics of overflows from combined sewers with those from separate storm sewers.

Generally, laboratory procedures were performed in accordance with "Standard Methods for the Examination of Water and Wastewater, Eleventh Edition." Any deviations were based on proven research described in the literature.

The main body of this report contains a narrative description of all major activities of the Project, accompanied by appropriate maps, graphs, and tables. All tables and figures are contained in the seven sections which constitute the main body of the report.

SUMMARY OF FINDINGS - DETROIT RIVER

Water Uses

The Detroit River is actually a strait connecting the waters of Lake St. Clair to those of Lake Erie. Its average discharge, based on United States Lake Survey records through April 1964, is 182,000 cubic feet per second. During the study period the discharge averaged 170,000 cubic feet per second.

The water uses of the Detroit River are as follows:

1. Shipping and navigation. Tonnage shipped through the Detroit during a recent eight-month season exceeded the entire combined tonnage shipped through the Suez and Panama Canals during an entire year. To maintain navigation, dredging operations are carried on in the Detroit River and Lake Erie by the U.S. Corps of Engineers.

2. Major staging area for migrations of waterfowl. Estimated winter populations since 1950 ranged from a minimum of 5,000 in 1961-1962 to 100,000 in 1963-64.

3. Recreation. There are at least 18 recreational areas and 63 marine facilities in the study area.

4. Water supply. Heavy use is made of the Detroit River for municipal and industrial water supply. The major municipal user is the City of Detroit, serving the water supply needs of over three million people both in Detroit and adjacent communities. Three municipal water supply intakes serving the Detroit area are located in the U.S. section of the Detroit River.

5. Sport Fishing. The fish of the Detroit River and adjacent waters of Michigan Lake Erie are a valuable natural resource providing recreation for many anglers in the metropolitan area. Sales of bait, tackle, and fishing gear as well as sales and rentals of boats and motors to sportsmen constitute a business activity of considerable economic importance to the area.

Description of Water Quality and Interference with Water Uses

Several prior investigations concerning water quality in the Detroit River have been made by government agencies and private consulting engineering firms during the last 50 years. Reports of these investigations show the progressive deterioration of the Detroit River water quality from headwaters to mouth due to municipal and industrial waste discharges.

Comparison of waste loadings discharged to the Detroit River during the 1948 IJC survey and the 1963 Public Health Service survey reveals over 50 percent reduction in phenols, cyanide, oil, and suspended solids from industrial sources during the 15-year period.

The water quality of the Detroit River from its head to its junction with the old channel of the Rouge River (approximately 10 miles downstream) is satisfactory during dry weather conditions. During overflows from combined sewers, the only part of the Detroit River free from pollution is the stretch above Conners Creek and midstream down to the Rouge River.

From their points of discharge all types of wastes had a tendency to hug the United States or Canadian shores and then slowly extend outward into the main body of the river. Thus the pollution is not as great in the middle of the River.

Bacterial Density. High total coliform densities, especially when accompanied by high fecal coliform densities, indicate the presence of animal (including human) wastes which may contain pathogenic organisms capable of causing enteric diseases in humans. The presence of these organisms above acceptable levels is a threat to the health and welfare of those who use this water for domestic water supply and recreational purposes. A widely used standard for swimming is 1,000 organisms per 100 ml.

Bacterial densities differed greatly between dry and wet weather conditions. During dry conditions the geometric mean coliform density in the upper Detroit River was under 500 organisms per 100 ml., with average values at the headwaters under 100 organisms per 100 ml. Below Zug Island and the Rouge River the geometric mean coliform densities increased to values exceeding 5,000 organisms per 100 ml. During wet conditions no change was noted at the head of the Detroit River, but below Conners Creek geometric means rose to approximately 7,000 per 100 ml. in the upper River and to over 80,000 in the lower Detroit River. During wet and dry weather almost all of the lower Detroit River has geometric mean values in excess of 2,400 organisms per 100 ml., and most of the lower Detroit River exceeds 5,000 organisms per 100 ml. during wet conditions.

Fecal coliform ratio to or percentage of total coliforms provides additional information on water quality. The range noted during the study was 30 to 90 percent of the total coliform densities, with higher values observed in the lower Detroit River during wet conditions. Fecal streptococci were generally less than either total or fecal coliforms.

Geometric mean densities depict only average conditions and tend to mask extremely high values. These high values can indicate significant effects on many water uses, especially those affecting human health

and welfare. Maximum values during the survey ranged from 4,900 organisms per 100 ml. at the headwaters to 770,000 organisms per 100 ml. in the lower River.

At the head of the Detroit River average total coliform densities were approximately the same during wet and dry conditions throughout the range. At all locations from just below Belle Isle to the mouth of the Detroit River average coliform densities near the United States shore during wet conditions were 5 to 10 times higher than corresponding values during dry weather. Study of the results of sampling in the Detroit River by personnel of the City of Detroit during the past four years indicates a pronounced downward trend (as evidenced by median values) in coliform densities in American waters near the shore, especially during the years 1962 and 1963.

Effluents from the main Detroit Sewage Treatment Plant, Wyandotte Sewage Treatment Plant, and overflows from combined sewers are significant sources of coliforms, fecal coliforms, and fecal streptococci to the Detroit River.

Four years of operating records of several area water and sewage treatment plants were evaluated. These records indicate a substantial reduction in monthly geometric mean coliform densities during 1962 and 1963 compared with the preceding two years, especially in the Detroit Sewage Treatment Plant effluent. A corresponding reduction in coliform density at the Wyandotte Water Treatment Plant was observed in these two years. Little change was noted in suspended solids in sewage effluent or influent in area plants during the period.

Monthly geometric mean values in several Detroit River sewage treatment plant effluents indicate substantial reduction during the past few years. During certain months with geometric mean values under 20,000 organisms per 100 ml., densities of daily samples varied widely, with daily averages frequently over 100,000 per 100 ml. Such erratic control of coliform organisms is not considered unusual when chlorination is practiced following primary sewage treatment.

Pollution from partially treated municipal wastes and overflows from combined sewers endangers the users of the domestic water supplies from the Wyandotte intake and, at times, users of the domestic water supplies from the Southwest intake of the City of Detroit in the event of a breakdown in the water treatment facilities. Pollution from these sources also interferes with recreational uses at all times in the lower Detroit River. Pollution originating from the Detroit and Wyandotte Sewage Treatment plants and combined sewers along the entire shoreline of the River must be abated to improve water quality and increase the uses of the Detroit River.

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BOD and DO. Insufficient dissolved oxygen in water can kill fish and other aquatic life or prevent their propagation. Low levels of dissolved oxygen can cause objectionable odors and thus interfere with recreation and aesthetic enjoyment.

Dissolved oxygen in the upper River is stable at 93 - 106 percent of saturation, but gradually diminishes to an average saturation of 67 percent at the mouth in that section of the River most affected by the Trenton Channel. The minimum observed value during the survey was 5.1 mg/l at the mouth.

The major sources of biochemical oxygen demand (BOD) are the effluents of the main Detroit Sewage Treatment Plant and the Scott Paper Company on the Rouge River.

While the present oxygen level in the lower Detroit River does not cause major interference with water uses, the drop from 100 percent saturation in the upper River to 67 percent in the lower is a warning of dire consequences in the future unless appropriate action is taken and represents a threat to water uses in the Detroit River and Michigan Lake Erie.

Suspended and Settleable Solids. Excessive amounts of suspended solids in water can cause interference with domestic and industrial water treatment processes, harmful effects to fish and other aquatic life by clogging the gills and respiratory passages of aquatic fauna, turbidity which interferes with light transmission, and can interfere with boating and aesthetic enjoyment of the water. When a part of the suspended solids settles out on stream and lake bottoms as sludge or bottom deposits, damage to aquatic life can occur since these deposits blanket the bottom, killing eggs and essential fishfood organisms and destroying spawning beds. When the suspended solids carry with them toxic material, aquatic life can be killed when the toxic materials leech out into the water above.

A substantial increase in suspended solids occurred in the Detroit River from its head to mouth with a range of 5 - 20 mg/l in the upper and 14 - 65 mg/l in the lower river. Setteable solids showed a similar increase from a range of 5 - 10 mg/l to 10 - 24 mg/l.

The largest contributor of suspended and settleable solids is the Detroit Sewage Treatment Plant. The Wyandotte Chemical Company is also a significant contributor of suspended and settleable solids.

Sludge banks are present and are particularly extensive near the mouth of the River as it empties into Lake Erie. These deposits of sludge are primarily due to suspended and setteable solids in municipal and industrial wastes discharging into the Rouge and Detroit Rivers. The bottom deposits caused by pollution create unfavorable environmental conditions for the propagation of game fish. Sludge deposits along the

shoreline and in marinas interfere with recreational use and the aesthetic enjoyment of water. Pollution in the form of these deposits interferes with navigation, requiring annual dredging operation to maintain channels, marinas, and harbor facilities.

Oil and Grease. Oil and grease were repeatedly observed in the Detroit River.

The major sources of oil are the main Detroit Sewage Treatment Plant effluent and several industrial sources.

Although good oil pollution control has been effected by the State regulatory agencies during wildfowl over-wintering periods, the continued presence of excessive quantities of this pollutant in waste effluent poses a constant threat to fish and wildlife, as well as interfering with recreational use of the water. Oil spills were observed during the study period by the Project.

Phenols. High levels of phenols in waters cause disagreeable taste and odors in drinking water, tainting of flesh in game fish, and may even result in fish kills when concentrations are excessive. Phenols are present in Detroit raw water supplies in sufficient concentration to cause disagreeable tastes and odors, and expensive water treatment procedures are required to eliminate the problem. Average phenol concentrations should not exceed 2 µg/l (ppb) and maximum values should not exceed 5 µg/l to prevent nuisance taste and odors in water supplies.

Average phenol concentrations in the Detroit River increased from 3 - 5 µg/l at its head to greater than 10 µg/l in the lower River, and 6 - 9 µg/l at the mouth. Average phenol concentrations at all ranges in the Detroit River exceeded recommended levels during the survey. Records of the International Joint Commission indicate high concentrations in the St. Clair River below known sources of phenolic wastes in Sarnia, Ontario, Canada.

The major sources of phenols are the main Detroit Sewage Treatment Plant effluent, which treats the wastes of numerous industries, and other industrial sources.

Excessive phenol concentrations in the waters and bottom muds of the Detroit River pose a threat to fish and other aquatic life and have interfered with domestic water treatment at the Wyandotte plant.

Chlorides. Chloride concentrations above certain levels can interfere with domestic and industrial water supplies by causing objectionable tastes in drinking water and corrosion in industrial processes.

Chlorides in the Detroit River increased from uniform concentrations of 7 - 10 mg/l at the head to average values ranging from 9 - 69 mg/l at the mouth. High values were observed in the Trenton Channel and at the mouth near the United States shore.

The principal contributors of chlorides to the Detroit River are the Allied Chemical Corporation, Pennsalt Chemical Company, and the Wyandotte Chemical Company.

Increases in chloride concentrations indicate a change in the mineral content of the Detroit River from head to mouth. Although these concentrations are not yet significant enough to cause major interference with water use, the doubling of chloride loadings in a 30-mile stretch of the river is of concern. Future action may be necessary to prevent an undesirable situation.

Iron. Excessive concentrations of iron in water can cause interference with domestic and industrial water supplies. Iron is toxic to certain species of fish and other aquatic life in relatively low concentrations. Iron concentrations should not exceed 0.3 mg/l (ppm) in the receiving stream to prevent interference with municipal and industrial water supply and to protect fish and wildlife.

Average iron concentrations in the Upper Detroit River meet recommended levels, but downstream the concentrations increase to average values of 0.52 mg/l. The iron concentration at the mouth ranges from 0.47 - 0.63 mg/l.

Although the Detroit Sewage Treatment Plant is a significant contributor of iron to the Detroit River, the largest sources of iron are the Great Lakes Steel Company and the Ford Motor Company.

Iron concentrations in the waters and bottom muds of the Detroit River pose threats to fish and other aquatic life and represent a potential interference with industrial water supply.

Nitrogen. Nitrogen compounds coupled with phosphorus can act as essential nutrients causing the growth of algae in bodies of water where other environmental factors are satisfactory. In small quantities these algae are desirable as a major source of food for fish. When algal growth exceeds certain limits, nuisances result from the blooms. They are unsightly, can result in obnoxious odors, and some species can be toxic to fish. The level of inorganic nitrogen compounds (nitrates, nitrites, and ammonia) above which undesirable blooms can be expected to occur is 0.30 mg/l.

Nitrogen compounds show a significant increase from the head to the mouth of the River. Inorganic nitrogen (nitrates, nitrites, and ammonia) increased from approximately 0.2 mg/l at the head to over 0.4 mg/l

at the mouth of the River. Ammonia increased dramatically below the Rouge River and Zug Island from a range of 0.08 - 0.14 mg/l to 0.16 - 0.41 mg/l. High ammonia levels at the Wyandotte water treatment plant, causing a variable chlorine demand, have necessitated greater chlorine dosages to assure a safe supply at all times. The presence of this material not only results in additional expense but also represents an interference with the effectiveness of chlorine in disinfecting water supplies, and thus is a potential hazard to the health and welfare of the users. High ammonia levels can be expected to cause similar problems at the new southwest intake operated by the City of Detroit.

The main source of nitrogen to the Detroit River is the effluent of the main Detroit Sewage Treatment Plant.

Essential nutrients for plant growth, including inorganic nitrogen compounds and phosphates, increase significantly from the headwaters to the mouth of the Detroit River. Excessive concentrations of these constituents cause interference with almost all legitimate water uses.

Phosphates. Soluble phosphates in relatively small concentrations are readily available as an essential plant nutrient. The insoluble portion of the total phosphate concentration can be converted to the soluble form and thus become available for such plant utilization. Soluble phosphates present in greater concentrations than 0.015 mg/l, reported as phosphorus, in combination with inorganic nitrogen compounds in excess of 0.30 mg/l and accompanied by satisfactory environmental conditions such as light and heat, may produce overabundant growths of algae with concomitant odors and detriment to fish life.

Phosphates (reported as phosphates) increased from average values of 0.03 - 0.30 mg/l at the head to 0.18 - 1.20 mg/l at the River's mouth. All but two soluble phosphate values in the upper Detroit River were less than 0.001 mg/l with the highest value located near the United States shore just downstream from the combined sewer outfall at Conners Creek. These values increased to a range of 0.176 to 0.204 mg/l at the mouth.

The main source of phosphates to the Detroit River is the main Detroit Sewage Treatment Plant effluent.

Biology. The waters of the Detroit River from head to mouth were found to contain low numbers of planktonic algae, with counts averaging 500 per ml. Low densities of animal plankton were also found. Plankton entering the river with water masses from Lake St. Clair were carried as a "standing crop" downriver to Lake Erie with little change in density or species composition either vertically or horizontally across the river. The rate of travel is too rapid for the domestic and industrial wastes to appreciably alter the number of plankton.

The bacterial slime Sphaerotilus was found, attached to bridge abutments, pilings, piers, buoys, etc., in abundant quantities in the Detroit River below the Rouge River and Detroit Sewage Treatment Plant outfall.

Composition of bottom organisms in the Detroit River changed from a pollution-sensitive population typically found in clean waters to a predominantly pollution-tolerant population in the lower areas of the River below Zug Island and the Rouge River. This change was especially pronounced along the United States shore. In the reach of the Detroit River from Zug Island to the mouth, habitats suitable for the support of a variety of bottom organisms have been destroyed by the deposition of organic solids and oils, especially in areas nearest the Michigan shore.

Clinging and burrowing mayfly nymphs, both pollution-sensitive organisms associated with clean bottom conditions, in themselves valuable as fish food, were found in the upper ranges of the Detroit River but were completely absent from the River below the Rouge River and Detroit Sewage Treatment Plant and in the entire Michigan waters of Lake Erie. Habitats in the lower Detroit River formerly suitable for the support of this once-abundant organism have been totally destroyed by pollution.

Sources and Characteristics of Wastes

A total municipal waste volume of 540 million gallons is discharged daily into the Detroit River, containing the following loadings of constituents:

1. Wastes equivalent in oxygen-consuming capacity to raw sewage from a population of over 3,000,000.

2. Innumerable coliform bacteria.

3. Over 25,000 pounds of iron.

4. Over 600,000 pounds of suspended solids and almost 300,000 pounds of settleable solids.

5. Over 16,000 gallons of oil.

6. Over 1,200 pounds of phenolic substances.

7. Over 34,000 pounds of ammonia.

8. Over 150,000 pounds of total phosphates, including 70,000 pounds of soluble phosphates.

9. Over 500,000 pounds of chlorides.

A total industrial waste volume of 1.1 billion gallons is discharged daily into the Detroit River, containing the following loadings of constituents:

1. Wastes having an oxygen-consuming capacity equal to raw sewage from a population of over 1,000,000.

2. Over 3,000 gallons of oil.

3. Over 800,000 pounds of suspended solids, of which almost 700,000 are settleable.

4. Over 1,400 pounds of phenols.

5. Over 8,000 pounds of ammonia.

6. Over 80,000 pounds in iron.

7. Over 2 million pounds of chlorides.

8. Over 200,000 pounds of acid.

TABLE 11-V. SOURCES OF INDUSTRIAL WASTES--ROUGE RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Allied Chemical Corporation					
General Chemicals Division	9.11	sulfuric acid, aluminum sulphate.	- -	acid	ponds, pH monitors.
Plastic Division	0.48	coal tar, pitch, oil.	-	phenols, NH_3	dephenolizers, settling, oil separators.
Semet-Solvay Division	5.9	high-grade coke and by-products	-	phenols	dephenolizer, oil separator
Solvay Process Division	15.2	soda ash	1,000 tons/day	suspended solids, chlorides, phenols	lagoons
American Agricultural Chemical Company	1.15	fertilizer, gelatin, fluoride salts	-	acid	none
Darling and Company	1.13	fats and meat meal	-	BOD, coliform, N, suspended solids, oil	sedimentation
Ford Motor Company	400	steel, castings, coke, glass, automobiles	-	phenols, CN, NH_3, iron, oil	oil separator, sedimentation, subsurface injection.
Peerless Cement Company	8.1	Portland cement	3 1/4 million barrels/year	suspended solids	none
Scott Paper Company	43.8	high-grade paper tissue	240 tons/day	BOD, pH, Susp. solids, phenols.	screening, clarifiers
TOTAL	484.87				

TABLE 12-V. SOURCES OF INDUSTRIAL WASTE--UPPER DETROIT RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Allied Chemical Corporation Solvay Process Division	6.4	soda ash	1,000 tons/day	suspended solids, chlorides, phenols	lagoons
Anaconda-American Brass Company	5.3	copper	-	toxic metals, acid	neutralization, settling
Great Lakes Steel Corporation Blast Furnace Division	90	coke, pig iron, coke by-products	-	iron, susp. sol., phenols, oil, NH_3, cyanides	clarifiers, dephenolizer
Parke Davis and Company	8.1	pharmaceuticals	-	none	none
Revere Copper and Brass Company	2.9	brass and copper	-	oil, toxic metal	oil separators
U.S. Rubber Company	42	tires	-	none	oil skimmers
TOTAL	154.7				

TABLE 13-V. SOURCES OF INDUSTRIAL WASTES - LOWER DETROIT RIVER

Industry	Volume (MGD)	Product	Production	Significant Waste Constituents	Waste Treatment or Control
Chrysler Corporation					
Amplex Division	0.32	gears	-	none	none
Chemical Products Division	0.27	chemical adhesives, brake linings, soluble oils	-	none	none
Engine Plant	1.1	engines	55,000/mo.	oil	air flotation and oil skimmer, chemical coagulation
Dana Corporation	0.38	auto and truck frames, trilevel RR car carriers	-	phenols, acid, oil, iron	none
E. I. duPont deNemours and Company	1.4	sulfuric acid, oleum	-	acid	none
Firestone Tire and Rubber Company	1.0	wheel rims	11,400,000 lbs./mo.	acid, iron, oil, suspended solids	oil separator, ponds, diffuser pipes
Fuel Oil Corporation	12,240*	ship washing	18 ships/yr.	oil, suspended solids	oil separator
Great Lakes Steel Corporation					
Hot Strip Mill	72	sheet steel	-	oil, iron, suspended solids	oil skimmers and settling basins
Rolling Mill	72	strip, sheet and bar steel	-	oil, phenols, acid, iron, suspended solids	oil separators
Koppers Company, Incorporated	0.8	naphthaline, paraffin epoxy resins	-	phenols, oil	none
McLouth Steel Corporation					
Gibraltar Plant	1.6	cold rolled steel	80,000 tons/mo.	acid, iron, suspended solids, oil	oil skimmers, lagoons
Trenton Plant	65.7	Stainless steel	2,530,000 tons/yr.	iron, suspended solids, oil	chemical coagulation, settling neutralization, oil separators
Mobile Oil Corporation	1.1	gasoline, naptha, kerosine, oils	-	phenols, oil, chlorides, suspended solids	oil separator, ponds
Monsanto Chemical Company	18	phosphates and detergent	-	phosphates, suspended solids	lagoons
Pennsalt Chemicals Corporation					
East Plant	97	chlorine, caustic, NH_3, hydrogen peroxide, acid, ferric chloride	-	NH_3, chlorine, chlorides, suspended solids	none
West Plant	6.8	organic chemicals	-	phenols, chlorides, suspended solids, oil, oxidizing agents	lagoons, oil skimmers
Shawinigan Resins Corporation and Monsanto Saflex Division	0.4	polyvinyl butyral Ethyl acetate	500,000 lbs/week	acid, BOD, suspended solids	lagoons, neutralization
Wyandotte Chemicals Corporation					
North Plant	57	soda ash, bicarb of soda, lime, calcium carbonate, cellulose	-	phenols, chlorides, suspended solids, nitrogen	lagoons
South Plant	54.7	chlorine, lime, glycol, cement, soda, dry ice	-	chlorides, suspended solids, phenols	lagoons, oil separator
Propylene Oxide Plant	1.0	propylene oxide	65 tons/day	chlorides, suspended solids	lagoons
TOTAL	452.57				

*gallons per hour when washing ship.

769-765 O-65—3

Stormwater Overflow Studies

Studies were performed jointly with the Michigan Department of Health and the Michigan Water Resources Commission to compare the characteristics of discharges from the combined sewers serving the City of Detroit (Conners Creek system) and the separate storm and sanitary sewers serving Ann Arbor, Michigan.

The following is a summary of waste constituents found in the stormwater overflows from combined sewers:

1. Total coliform, fecal coliform, and fecal streptococcus densities many times approached values found in raw sewage. Coliform counts of over 100,000,000 organisms per 100 ml were found during summer months. Lower results were found in the winter.

2. Total coliform densities in the separate stormwater system at Ann Arbor regularly exceeded 1,000,000 organisms per 100 ml. Average total coliform densities from the Detroit combined system were approximately 10 times higher than those in the Ann Arbor separate system. Fecal coliform densities were found to be approximately 30 times greater than similar values in the separate system, while comparable fecal streptococcus levels were at least twice as high.

3. Phenol, BOD, phosphate, ammonia, and organic nitrogen concentrations were two to five times higher in the combined overflow than in separate storm discharge.

4. In the Detroit area, rainfall sufficient to cause overflows from all combined sewers (0.3 inch) can be expected to occur approximately 33 days each year. Rainfall sufficient to cause overflows from certain parts of the system (0.2 inch) can be expected to occur about 45 days each year.

5. Calendar year 1963 was the driest on record for the City of Detroit according to rainfall records of the U.S. Weather Bureau. Even during this year, the Conners Creek pumping station was observed to overflow 12 times during a 6-month period in 1963. During the first 12 months of operation of the automatic sampler, the Conners Creek installation overflowed and collected samples 23 separate times. Both figures exclude the period of raw sewage bypass from this station by the City of Detroit.

6. The volume of overflow at the Detroit installation during the survey varied from 40 million gallons to 509 million gallons. The greatest volume was observed during the overflow of longest duration. This volume, which originated from only 25 percent of the City of Detroit, is approximately the same as the daily discharge of partially treated sewage from all sewage treatment plants into the Detroit River.

7. Volume figures indicate a discharge into the Detroit River of 4 $\frac{1}{4}$ billion gallons from the combined sewers serving the Conners system during the first year of operation of the sampling station.

8. It is estimated that 2 percent of the total raw sewage contributed to the Detroit area sewers reaches the Detroit River each year. This is over 5 billion gallons of raw sewage contributed to the Detroit River from this source each year. This figure should be considered conservative since the Conners system is designed for more storage capacity than many other combined sewers in the Detroit and downriver collection systems.

Total bacterial densities were found to increase from the head waters to the mouth during a typical overflow. The following is a summary of data on bacterial densities:

1. Coliform, fecal coliform, and fecal streptococcus densities increased in the Detroit River, following an overflow from combined sewers, 10 to 50 times over the values found during dry weather conditions.

2. Coliform densities in the Detroit River following an overflow often exceeded 300,000 organisms per 100 ml and at times exceeded 700,000 organisms per 100 ml.

3. All high bacteriological values in the Detroit River during or following an overflow were found below Conners Creek. Bacteriological densities above this point stayed fairly constant during wet and dry conditions. Conners Creek represents the farthest upstream location on the Detroit River of many combined sewer outfalls.

4. City of Detroit sampling records show individual values exceeding 800,000 organisms per 100 ml in the Detroit River on the day following significant rainfall.

5. High bacteriological densities following overflows were found at both the City of Wyandotte water intake and the new intake of the City of Detroit near Fighting Island. The Wyandotte values exceeded 100,000 organisms per 100 ml and the Fighting Island values 10,000 organisms per 100 ml.

6. Rainfall, overflow, and stream quality records show that during a 9-month period in 1963 (March - November) overflows from combined sewers affected water quality in the Detroit River during part or all of 88 days. This represents 32 percent of the days in the 9-month period. This phenomenon occurred during the year of lowest accumulated rainfall and implies an even greater effect on Detroit River water quality during a year of normal rainfall.

During heavy rains causing overflow, visual observations were made of the Detroit River by Project field personnel, who noted condoms, debris, and garbage as well as excrement floating down the River.

Special Studies

Several special studies were conducted by the Project to provide additional information on complex problems. The following were investigated:

1. The effect of pollution originating from unsewered homes or from inadequately functioning installations on Grosse Ile.

2. Growth and die-off of bacteria in the Detroit River.

3. Bypass of 75 MGD of raw sewage for 10 consecutive days by the City of Detroit during November 1963.

4. Detroit's bypassing of treated effluent through an alternate outfall to the Rouge River and its adverse effect on water quality in the lower Detroit River.

5. Physical and chemical characteristics of deposits on the bottom of the Detroit River.

6. Distribution of flow in the Detroit River by dye tracer studies.

7. Tributaries of the Detroit River thought to be of significance in the contribution of industrial or domestic wastes and subsequent deterioration of the main river.

Detailed information on the results of these studies can be found in Section V in the main body of the report.

Interferences with Water Uses

Municipal Water Supply. Two municipal water intakes in the Detroit River, the Southwest City of Detroit intake and the Wyandotte intake, receive water with bacterial counts frequently high enough to pose a health hazard in the event that water treatment facilities should malfunction. Furthermore, ammonia levels at the Wyandotte intake are high enough to lessen the effectiveness of normal disinfection procedures, and phenols cause taste and odor problems.

Industrial Water Supply. The water supply of several industries is interfered with by high chloride concentrations in the Detroit River, but the Project staff was unable to obtain statements to this effect from the industries concerned.

Recreation. Pollution has necessitated that all beach areas on the Detroit River below Belle Isle be posted as unsafe for swimming and other water-contact sports. Thus 26 out of the 31 miles of the Detroit River have had their recreational usefulness greatly diminished. At the same time, many people ignore the warnings of State and local health authorities, and swim and water-ski in the restricted area. For these people, pollution in the River presents an immediate health hazard. Boaters and owners of marinas along the lower River are constantly harassed by oil slicks and sludge deposits, which deface boats and boat equipment, fill in and foul docking facilities, and create an aesthetic nuisance.

Fish and Wildlife Propagation. Creel census records indicate a change in the predominant types of fish in the Detroit River from a variety of desirable game fish to a predominance of carp and yellow perch. The destruction of 10,000-12,000 wildfowl four years ago has been attributed to oil pollution.

Navigation. Sludge deposits at the junction of the Rouge and Detroit Rivers and at the mouth of the Detroit River require extensive annual dredging by the U.S. Army Corps of Engineers to maintain routine navigation.

SUMMARY OF FINDINGS - LAKE ERIE

This study was limited to the Michigan waters of Lake Erie, which constitute approximately 1 percent of the surface area of this international body of water. Lake Erie is the shallowest of all the Great Lakes, and the greatest recorded depth in its Michigan waters is only 29 feet. Most of the water flowing into Lake Erie is from the Detroit River.

Description of Water Quality

The Michigan waters of Lake Erie have two major zones of pollution -- one in the vicinity of the mouth of the Detroit River, one near the mouth of the Raisin River. These waters are polluted bacteriologically, chemically, physically, and biologically; they contain excessive coliform densities, suspended solids, nitrates, ammonia, organic nitrogen and phosphates, and sludge deposits.

Bacterial Density. Sewage commonly contains many pathogenic organisms that can cause gastrointestinal diseases, eye, ear, nose and throat disorders, skin infections, and hepatitis when ingested. These organisms may include both bacteria and viruses. They are usually measured by counting the number of coliforms (bacteria particularly associated with human or animal excreta).

The maximum density of coliform bacteria recommended in this report - 1,000 organisms per 100 ml. - is exceeded for 2 to 3 miles south of the mouth of the Detroit River and for approximately 1 mile out from the mouth of the Raisin River. Maximum coliform values showed a similar pattern of dispersion, with individual values exceeding 100,000 organisms per 100 ml. found near the mouths of the Raisin and Detroit Rivers. Fecal coliform densities ranged from 5 to 30 percent of the total, and geometric mean fecal streptococci were less than 80 per 100 ml. at all locations.

All bathing beaches along the Michigan shore of Lake Erie had geometric mean coliform densities of less than 1,000 organisms per 100 ml., except Maple Beach, located in the influence of the Detroit River. Geometric mean coliform densities at Sterling State Park beaches approached 1,000 organisms per 100 ml., but here relatively low means mask exceptionally high individual values which appeared under certain conditions of wind and weather, some exceeding 100,000 organisms per 100 ml. These maximums represent a hazard to health of water users. Fecal coliform and fecal streptococcus densities along the Lake Erie beaches were noticeably higher than in adjacent Lake waters.

Bacteriological densities in Lake Erie from the mouth of the Detroit River to a point 2 to 3 miles to the south are such that the water cannot safely be used for recreational purposes. Following heavy rainfall in the Detroit area, the zone of polluted water extends southward to Stony Point and outward from the Raisin River.

Dissolved Oxygen. Most of the Michigan waters of Lake Erie display high levels of dissolved oxygen. Two areas of low values were found near the mouths of the Detroit and Raisin River, with the more widespread effect radiating southward from the mouth of the Detroit River. In the immediate vicinity of the mouth of the Raisin River, complete depletion of oxygen was found, but within one-half mile into the Lake the levels recovered. Values as low as 4.8 mg/l and 58% saturation were found in the area south of the mouth of the Detroit River. Here the area of depressed values extends southwest 4 - 6 miles.

While present oxygen levels in the Lake do not yet cause major interferences with water use, the drop to 4.8 mg/l represents a threat to water uses in the Lake. Unless appropriate remedial action is taken now, the situation will almost certainly worsen.

Phenols. Average phenol concentrations ranged from 1 to 16 µg/l, with 5 out of 23 Lake stations exceeding 2 µg/l. Nine out of 17 beach stations had phenols averaging over 2 ug/l, but all were under 5 µg/l. Five out of 7 tributaries showed phenols averaging over 2 µg/l, but only 2 exceeded 4 µg/l.

Phenols can cause disagreeable tastes and odors in drinking water, taint the flesh of fish, and, in high concentrations, kill fish and other aquatic life. There is no evidence of damage to Lake Erie water use by phenols at this time.

Chlorides. Average chloride concentrations in the Michigan waters of Lake Erie ranged from 18 to 44 mg/l, with the higher values along shore and near the mouth of the Detroit River. Chlorides can interfere with domestic and industrial water use by causing objectionable tastes and odors in drinking water and corrosion in industrial equipment. While present levels do not interfere with water use, the year-by-year increase at the Monroe water intake is noted as a warning of future problems.

Suspended and Settleable Solids. Suspended solids concentrations near Lake Erie bathing beaches ranged from 80 - 165 mg/l; Lake Erie itself had concentrations of 11 to 25 mg/l. Suspended solids in Lake Erie were highest near the mouths of the Raisin and Detroit Rivers, and have reached levels which interfere with water uses by settling out on the Lake bottom. These bottom deposits interfere with navigation, kill fish eggs and fish-food organisms, destroy spawning beds, and clog the gills and respiratory passages of fish.

Cyanides. Cyanides were found at the mouth of the Raisin River and once at Sterling State Park nearby in concentrations exceeding PHS drinking water standards and recommended maximums for protection of fish. Their presence in the water, even in minute quantities, poses a threat to fish and wildlife.

Iron. Average iron concentrations exceeding 0.30 mg/l were found near the mouth of the Detroit and Raisin Rivers. Iron is toxic to certain species of fish even in low concentrations; excessive quantities of iron can also cause tastes in municipal water supplies and stains in laundry, vegetables and plumbing fixtures.

Nitrogen. A pattern of high concentrations of nitrogen compounds radiates outward from the Detroit River. High levels of nitrates ranging from 0.35 to 0.50 mg/l were found in Brest Bay, and ammonia concentrations exceeding 0.30 mg/l extended down into the Lake approximately 10 miles from the mouth of the Detroit River. Inorganic nitrogen exceeds 0.30 mg/l in over 85 percent of the Michigan waters of Lake Erie.

Nitrogen in Lake Erie acts as a nutrient for algae and undesirable slimes which, in turn, can result in obnoxious odors; ammonia in particular interferes with domestic water treatment.

Phosphates. Phosphates also nourish objectionable algae and slimes, which add to general turbidity. Areas of high total phosphate concentration (0.20 - 0.50 mg/l) extended from the Detroit River south to Stony Point. Three areas of soluble phosphate exceed 0.10 mg/l as phosphate or 0.03 as phosphorus. One extends 6 - 8 miles south from the mouth of the Detroit River, one radiates out 1 - 2 miles from the Raisin River, and the third extends upward 3 - 4 miles from the Ohio State Line.

Over 85 percent of the Michigan waters of Lake Erie contain inorganic nitrogen and soluble phosphates in excessive concentrations. The result has been undesirable algal blooms and serious interferences with water use. The City of Monroe has already been forced to move its water supply intake in order to avoid objectionable tastes and odors from algae.

Biology. Massive colonies of the filamentous slime bacteria Sphaerotilus, or "sewage fungus", and the filamentous green alga Cladophora were found at most stations in Lake Erie and along the bathing beaches near Bolles Harbor and in Brest Bay. These slimes, indicative of pollution, have fouled the nets of fishermen, interfered with boating, and washed up on beaches decaying and smelling.

Lake Erie also supports dense populations of plant and animal plankters, sometimes as dense as 22,425/ml. These microscopic, free-floating animals, in large numbers, can create nuisances: they clog filters in water plants, produce unpleasant tastes and odors in drinking water, and make the Lake water highly turbid.

Study of the bottom animal associations revealed polluted areas adjacent to the Raisin River and Sterling State Park, and at the mouth of the Detroit River extending in the shape of a fan out into the Lake. Samples from the River below sources of pollution and from the Lake did not contain a single burrowing mayfly. The elimination of pollution-sensitive organisms such as these rob fish of much food, and may threaten certain species of fish with extinction.

Sources and Characteristics of Wastes

Over 95 percent of the waste constituents discharged from Michigan sources to Lake Erie originates from the Detroit River. The daily discharge from the United States portion of the River into Lake Erie contains the following loadings:

1. Over 10,000,000 pounds of chlorides.
2. Over 2,000 pounds of phenols.
3. Over 7,000,000 pounds of settleable solids.
4. Over 250,000 pounds of iron.
5. Over 200,000 pounds of phosphates.
6. Over 130,000 pounds of ammonia.
7. Over 300,000 pounds of total nitrogen.

After the Detroit River, the major polluter of Michigan Lake Erie is the Raisin River. The chief municipal waste discharge to the Raisin is from Monroe. The Monroe Sewage Treatment Plant provides primary treatment and, during the summer, chlorination, and its operation is excellent. Efficiency in removal of suspended solids (62%) and BOD (59%) is high for a primary treatment plant, and bacterial control during chlorination is also good.

Although Monroe has separated its sewer system, a portion of the sanitary sewers still receives runoff from roofs during and after rainfall. This results in hydraulic overloading at the plant, with a subsequent drop in efficiency, especially in maintenance of a chlorine residual in the effluent which will adequately reduce coliform organisms.

During the summer most bacterial loadings discharged to the Raisin River and subsequently to Lake Erie from the Monroe plant are significantly less than those from industrial sources. During non-chlorination months, however, the municipal plant is a significant source of coliform organisms to the Raisin River. Nitrogen and phosphorus compounds in the River originate in almost equal proportions from industrial and municipal sources.

Monroe industries discharge, daily, to the Raisin River:

1. Wastes equivalent in oxygen consuming capacity to raw sewage from a population of 225,000.

2. Over 23,000 pounds of suspended solids, including 7,800 pounds of settleable solids.

3. Over 1,000 gallons of oil.

4. Over 1,000 pounds of cyanides.

5. Over 1,000 pounds of phosphates.

6. 16,000 pounds of chlorides.

7. Coliform bacteria with maximum densities more than 3 million per 100 ml.

8. Fecal coliforms with maximum densities more than 100,000 per ml.

9. Fecal streptococci with maximum densities more than 51,000 per 100 ml.

The lower Raisin River is frequently completely devoid of dissolved oxygen, resulting in a continuous state of putrefaction during the summer months. All uses of the lower Raisin River except waste disposal and navigation have been eliminated by pollution and deposits of setteable solids. Navigation is also hampered, and extensive annual dredging at the mouth is required to remove deposited wastes and keep the channels open for routine ship movement. Bacterial counts in the lower River make any recreational use of the water hazardous. The detrimental effect of the Raisin River upon the Lake is evident in the enrichment of the waters of the western basin and the high coliform levels at bathing beaches nearby (including Sterling State Park).

In addition to the Raisin River, several other tributaries to Lake Erie contribute wastes: They are the Huron River, Swan Creek, Stony Creek, Sandy Creek, Plum Creek and LaPlaisance Creek, with the Huron the most important. The Huron River carries significant quantities of coliform organisms, nitrates, and phosphates. It discharges into a large marsh at Pointe Mouillee with no clear pattern of dispersion into the Lake. The marsh is subject to backwater from the polluted waters of the Detroit River discharging into the Lake, and the specific effect of the Huron on the Lake is masked by this phenomenon. Long retention in the Pointe Mouillee marsh further complicates an evaluation of the Huron's share in polluting the Lake. After sources of pollution in the Detroit River have been substantially reduced, the actual waste contribution of the Huron River may be determined.

Sandy Creek discharges into Lake Erie at the northern edge of Sterling State Park, and is usually of poor bacteriological quality. Much of the time its flow is reversed, since the intake of the Ford Motor Co. plant and several paper mills that use its water exceed its normal flow. At periods of high runoff, however, its flow is higher (up to 60 cfs), and on such occasions it had an adverse effect on Lake Erie water.

Stony Creek and a small boat harbor near its mouth also have high coliform densities, and in times of heavy rain contributed wastes to the Lake.

Another important source of waste discharge into Lake Erie is storm-caused overflow. All along Lake Erie are shorefront pumping stations designed to receive surface drainage and automatically discharge it, untreated, into the Lake during or following rainfall. Discharge from improperly functioning septic tanks reaches the pumping stations along with surface storm runoff. A portion of Monroe's sanitary sewers still receives roof runoff, and this burdens the sewage treatment plant which must bypass directly to the River, without treatment except chlorination, all wastes over 10 MGD. In addition, a flood relief pumping station along the Raisin River interceptor bypasses the plant when unusually heavy rainfall or flood stage of the River inundates the sewer. The effect of storm-caused overflow on the River is most evident above known sources of pollution. In August 1963 a heavy rain caused the flood pumping station to operate for one hour, and coliform densities jumped to 10 times normal levels.

Unsewered shorefront houses also discharge sewage directly, or from improperly functioning septic tanks, to Lake Erie. Several tributaries, including Plum Creek and Sandy Creek, also receive such wastes.

Commercial and pleasure boats make heavy use of the Michigan waters of Lake Erie, and all such craft represent potential sources of pollution from oil and human wastes. Several reports of oil spills in the middle of the Lake waters under study indicate actual pollution from these sources.

TABLE 12-VI. SUMMARY OF AVERAGE DAILY LOADING OF INDUSTRIAL WASTES BY EACH INDUSTRY TO RAISIN RIVER AT MONROE

Industry	BOD lbs.	BOD P. E.	Susp. Sol. lbs.	Sett. Sol. lbs.	Chlorides lbs.	Oil gal.	Phenols lbs.	Cyanides lbs.	Copper lbs.	Chro-mium lbs.	Phos-phates lbs.
Consolidated Paper North Plant	17,204	101,000	7,823	780	0	123	11.0	0	0	0	-
Consolidated Paper South Plant	7,000	42,000	10,600	5,300	0	36	0.5	0	0	0	9
Ford Motor Company	48	287	8	3	16,000	870	3.8	1,075	700	136	1,046
Monroe Auto Equipment	NO WASTE CONSTITUENTS OF SIGNIFICANCE										
Monroe Paper Products	1,900	11,400	1,475	1,400	120	5	0.6	0	3	0	0
Union Bag-Camp Paper Co.	11,770	70,000	3,587	320	0	92	5.9	0	0	0	0
Total Raisin River(1)	37,900	225,000	23,500	7,800	16,000	1,130	21.8	1,075	703	136	1,060

(1) Rounded to three significant figures.

Special Studies

In connection with the overall study of Lake Erie, several special studies were carried out on specific pollution problems not clearly defined by the routine investigations. The special studies included: three intensive surveys of the Raisin River, a pollution study of the Maple-Milleville Beach area, collection and analysis of bottom deposits in the Lake, hydrologic and current studies, and an investigation of bacterial contamination at Sterling State Park. (Results from the first three studies have been reported in the main body of this summary.)

Hydrologic Studies. The hydrologic studies showed, in general, that wind is the primary factor influencing water movement in the Michigan waters of Lake Erie except in the Detroit River debouchment where flow from the Detroit River is the predominant factor. Specific findings of special interest include the following:

1. The combination of wind patterns and Detroit River flow is such that polluted Detroit River water can affect water quality at beaches as far south as Swan Creek 75 to 85% of the time.

2. Predominant winds are southerly, producing northerly currents 40 to 45% of the time. Northerly currents in turn bring polluted Raisin River water up to Sterling State Park beaches, accounting in part for the erratically high bacterial counts observed there.

3. Winds from the northeast and east, which occur approximately 20% of the time, could bring polluted Detroit River water into Brest Bay if they blew steadily two days or more.

Sterling State Park. Study of bacterial contamination at Sterling State Park beach revealed several sources of the pollution. The Raisin River, as mentioned above, is probably the chief contributor of high coliform counts, since northerly currents are predominant. When southerly currents prevail, waste discharges from tributaries to the north of the Park, and from malfunctioning septic tanks affect the beach water. Control of these sources of pollution should restore water quality at the Park to levels safe for swimming.

Interferences with Water Uses

Municipal Water Supply. Algal growths in Lake Erie have in the past caused serious taste and odor problems in the public water supply of Monroe, and threaten to do so again. Ammonia concentrations at the Monroe water intake tend to lessen the effectiveness of chlorination.

Industrial Water Supply. Increasing chloride levels are a warning of future difficulties, for chlorides can cause corrosion in industrial equipment. The Raisin River is so grossly polluted in its lower reaches that it is offensive to sight and smell, and undesirable as a source of industrial water supply.

Recreation. Restriction of recreational opportunities in Lake Erie and its Michigan tributaries may be the worst damage from pollution, inestimable in dollar figures. At beaches near the mouth of the Detroit River, any kind of water contact sports--even water skiing or boating--is hazardous. The beaches at Sterling State Park, in heavy demand by a metropolitan population of nearly four million (projected to reach 5½ million by 1980), have had to be posted as unsafe for swimming. The beaches themselves are often offensive due to the washing ashore of rotting plant life and decomposing matter of sewage and industrial origin.

Fish and Wildlife Propagation. Sludge deposits on the bottom of Lake Erie threaten to destroy the food and habitat that make life possible for game fish. Large areas of Michigan Lake Erie's bottom are inhabited only by pollution-tolerant organisms such as leeches and sludgeworms. Fish kills have been caused by discharges of oil and in 1960 a heavy discharge of untreated waste killed 10,000 to 12,000 ducks near the mouth of the Detroit River. Heavy algae blooms and dense populations of plankton add to the turbidity of the Lake water.

Navigation. Sludge deposits at the mouth of the Raisin and Detroit Rivers require expensive annual dredging to preserve routine navigability.

Eutrophication of the Lake. The natural aging of the Michigan waters of Lake Erie is being accelerated by the discharges of nutrients and organic wastes. If these discharges are not halted, fertilization in the Lake may increase until it becomes unusable for most purposes.

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RECOMMENDATIONS

I. INTRODUCTION

Recommendations for abating water pollution interfering with water use in the Detroit River, the Michigan waters of Lake Erie, and their tributaries will be made in two groups: general recommendations, covering the broad objectives of pollution abatement in the Project area, followed by specific recommendations for the solution of particular problems. All recommendations concerning municipal and industrial wastes refer only to Michigan facilities whose discharges reach the Detroit River or Lake Erie either directly or through a tributary.

The specific recommendations are offered in addition to, and not in place of, the general recommendations.

The recommendations which limit the effluent concentration of a particular waste constituent are made with the goal of reduction of overall loadings from a facility. If changes in concentration are brought about by increased dilution, combination of outfalls, or other methods without reducing waste loading, a corresponding decrease in recommended waste concentrations will be required.

While artificial fertilization of the Michigan waters of Lake Erie is a severe problem, no recommendations are made at this time concerning the installation of specialized treatment facilities designed to reduce phosphorus and nitrogen compounds in the effluent of municipal waste treatment works. Proper operation of secondary treatment facilities of the activated sludge type will result in significantly greater removal of these constitutents than that produced by primary treatment alone.

II. GENERAL RECOMMENDATIONS

The following are the general recommendations of the Detroit River-Lake Erie Project staff.

It is recommended that:

1. All municipalities provide a minimum of secondary treatment plus adequate disinfection of the effluent.

2. Sewerage systems with collection sewers terminating in adequate treatment facilities be provided in those areas along the Michigan shore of Lake Erie and the Detroit River where sewers do not now exist and homes discharge either raw wastes or septic tank effluent to the watercourse.

3. All industries in the area discharging waste material to the public waters maintain an inventory of all waste treatment equipment and supplies on the plant premises so that a minimum delay in effective waste treatment will result when replacement or repair is necessary.

4. A program be developed to reduce the likelihood of accidental spills of waste material to the river. In-plant surveys with the purpose of anticipating possible accidents are recommended.

5. All new sewerage facilities be designed to prevent the necessity of bypassing untreated wastes during maintenance and renovation operations.

6. Municipal waste treatment plants regularly analyze all waste constitutents contributing to pollution found in significant quantities in their wastes, as specified by the Michigan Water Resources Commission.

7. Industries discharging wastes to the public streams furnish operating records to the Michigan Water Resources Commission containing information on waste discharges and concentrations as specified by the Commission.

8. Regular monitoring of the Detroit River, Lake Erie, and their tributaries be conducted cooperatively by the Michigan Water Resources Commission and the Public Health Service. Such monitoring should include regular sampling of waste effluents and overflows from combined sewers. Use of aerial techniques for reconnaissance and pollution surveillance as practiced by the Michigan Water Resources Commission is encouraged and expansion of this activity recommended. Monitoring should include surveillance of oil discharge from vessels.

9. A PHS Water Pollution Control Surveillance Station (formerly National Water Quality Network Station) be established in the lower

section of the Detroit River. This would be in addition to the network station now in operation at the head of the Detroit River. Two stations would illustrate the waste burden put into the Detroit River and the change in its condition as it flows toward the Lake as well as indicate changes in water quality after improvements have been made.

10. The U.S. Department of Health, Education, and Welfare, through the auspices of the International Joint Commission, bring to the attention of Canadian water pollution control authorities the significant waste contributions from Canadian sources on the Upper St. Clair River adversely affecting water quality in the United States section of the Detroit River. They should be encouraged to bring about more effective pollution abatement to protect downstream water use.

III. SPECIFIC RECOMMENDATIONS

A. Detroit River

1. Municipal Waste Treatment

Detroit (Belle Isle Sewage Treatment Plant)

This plant discharges an effluent of low waste concentrations, and treatment efficiency is within accepted limits for this type of facility. Total coliform and fecal streptococcus densities in the effluent were high (7,890,000 and 297,000) but should be expected in this type of plant without chlorination.

The City of Detroit plans to abandon this plant and pump sewage from Belle Isle across to the mainland and into the Detroit system. Such a plan is recommended as the most practical under the circumstances. Until this plan can be carried out, it is recommended that full-time chlorination of the plant effluent be instituted, capable of producing an effluent with monthly geometric mean coliform densities not exceeding 5,000/100 ml. This recommendation is made to prevent interference with municipal water supplies and recreational use of water.

Detroit (Main Treatment Plant)

Sewage influent at the Detroit plant is of average strength from the standpoint of BOD and suspended solids concentrations but contains high levels of waste constituents normally not associated with municipal wastes, including oil and grease, phenols, copper, iron, chromium, nickel, zinc, and lead.

Average phenol and oil concentrations in the effluent exceed 20 mg/l and 15 mg/l respectively. Ammonia-nitrogen concentrations and loadings in the effluent are excessive, as is the phosphate effluent concentration (36 mg/l and 145,000 lbs/day). Efficiency in removal of settleable solids (52%), suspended solids (39%), and BOD (17%) is poor, indicating an overloaded and in some respects inadequate primary facility (e.g., the holding time in the settling basins is less than one hour).

Bacteria removal during the survey was excellent and density in the effluent very low. This presumably was accomplished by raising the level of chlorination; and while averages during the survey do not correspond with mean monthly averages during the study period, they show that effective bacterial control can be accomplished.

Waste loadings from the main plant of the City of Detroit are not only responsible for a large part of the degradation of the waters of the lower Detroit River but also constitute a major source of nitrogen compounds and the major source of phosphates going into and contributing to the fertilization of Lake Erie. The major contribution of waste constituents from municipal sources being discharged into the Detroit River and subsequently into Lake Erie originates from this plant.

It is recommended that:

1. A minimum of secondary treatment facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

   c. Ammonia concentration of 2 mg/l

   d. Phenol concentration of 20 μg/l

   e. Oil concentration of 15 mg/l

   f. Biochemical oxygen demand of 20 mg/l

2. Bacterial reduction facilities be operated at levels capable of providing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml.

3. A technical committee appointed by the conferees will evaluate actual phosphate removal of the secondary treatment plant after it is in operation. On the basis of this evaluation, if further facilities for the removal of phosphates are necessary, the conferees will consider making such a recommendation. A similar program will be put into effect concerning removal of nitrogen compounds.

The above recommendations have been made to prevent interference with domestic water supplies, recreational use of water, navigation, and fish and wildlife propagation.

Wayne County Sewage Treatment Plant (Wyandotte)

The plant was greatly overloaded when the Project began, and it was necessary to bypass untreated wastes for a portion of most days to the Detroit River, Enlargement of primary facilities was designed to alleviate this condition. The surveys performed at this plant by the Project staff were made on the original facilities, and do not reflect the recent enlargement.

Two surveys at this plant revealed an influent sewage of average strength in terms of BOD and suspended solids, but with other waste constituents at levels normally not associated with domestic sewage (phenols, oil and grease, iron, chromium, copper, cadmium, nickel, zinc, and lead).

Average concentrations of suspended solids and settleable solids and discharges to the River were high during the two surveys. Average BOD in the effluent during the first survey was 120 mg/l, with a population equivalent of 132,000 discharged. Levels of nitrogen compounds were significant, and phosphate concentrations were at 40 mg/l (unusually high) with a loading of 7,200 pounds per day.

Bacteriological control was excellent during the first survey when chlorination of the effluent was practiced. Geometric mean densities for total coliforms, fecal coliforms, and fecal streptococci during the first survey were less than 100 organisms per 100 ml. Study of plant operation records reveals that these results were not typical, but it is encouraging to note once again that results in this magnitude can be obtained. During the second survey effluent chlorination was not practiced, and geometric means for total coliforms, fecal coliforms, and fecal streptococci exceeded one million per 100 ml.

Discharges of suspended solids, nitrogen compounds, phosphates, and organic matter from the Wyandotte plant contribute significantly to the degradation of the Detroit River and the fertilization of Lake Erie.

It is recommended that:

1. A minimum of secondary treatment facilities be provided capable of producing an effluent containing not more than:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

   c. Oil concentration of 15 mg/l

   d. Biochemical oxygen demand of 20 mg/l

2. Bacterial reduction facilities be operated at levels capable of providing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

3. A technical committee appointed by the conferees will evaluate actual phosphate removal of the secondary treatment plant after it is in operation. On the basis of this evaluation, if further facilities for the removal of phosphates are necessary, the conferees will consider

making such a recommendation. A similar program will be put into effect concerning removal of nitrogen compounds.

The above recommendations are made to protect recreational use of water, navigation, and fish and wildlife propagation.

Wayne County Sewage Treatment Plant (Trenton)

It is recommended that:

1. A minimum of secondary treatment facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

2. Bacterial reduction facilities be operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

The above recommendations are made to prevent interference with recreational use of water and fish and wildlife propagation.

Wayne County Sewage Treatment Plant (Grosse Ile)

It is recommended that:

1. A minimum of secondary treatment facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

2. Bacterial reduction facilities be operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

The above recommendations are made to prevent interference with recreational use of water and fish and wildlife propagation.

2. Industrial Waste Treatment

Upper Detroit River

Allied Chemical Corporation (Solvay Process)

Wastes from this plant have high concentrations of suspended and settleable solids, phenols, and chlorides. Chloride loadings from this source represent approximately 20 percent of the entire industrial loading to the Detroit River. Suspended and settleable solids loadings and effluent concentrations indicate a lack of waste control.

It is recommended that:

1. Facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

2. The industry begin investigation of satisfactory methods of disposing of chlorides and alternate methods of disposal of concentrated brines, such as subsurface disposal.

The above recommendations are made to prevent interference with navigation and fish and wildlife propagation and to protect municipal and industrial water supply.

Anaconda-American Brass Company

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Lake Erie.

Great Lakes Steel Corporation - Blast Furnace Divisions

Waste treatment facilities provided for the removal of phenols and suspended solids are ineffective. Nearly 100 percent of the suspended solids in the plant effluent were found to be readily settleable.

It is recommended that:

1. Facilities be provided capable of producing an effluent not to exceed:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

c. Phenol concentration of 20 µg/l

d. Ammonia concentration of 2 mg/l

The above recommendation is made to prevent interference with municipal water supplies, navigation, and fish and wildlife propagation.

Parke-Davis Company

Waste treatment at this installation is considered satisfactory at this time, and no specific recommendations for improvement are made.

Revere Copper and Brass, Inc.

The concentrations of oil and settleable solids in the effluent from this installation are excessive. All of the suspended solids released by this industry are readily settleable.

It is recommended that:

Facilities be provided capable of producing an effluent containing not more than:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

c. Oil concentration of 15 mg/l

This recommendation is made to prevent interference with navigation and fish and wildlife propagation.

United States Rubber Company

Waste treatment at this installation is considered satisfactory at this time, and no specific recommendations are made.

Rouge River Industries

Allied Chemical Corporation (General Division)

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

Allied Chemical Corporation (Plastics Division)

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

Allied Chemical Corporation (Semet-Solvay)

Wastes discharged from this source, with the exception of oil discharges as reported by the Michigan Water Resources Commission, were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

Allied Chemical Corporation (Solvay Process)

Wastes from this plant have excessively high concentrations of phenols and chlorides. Chloride loadings represent approximately 10 percent of the entire industrial load to the Detroit River. Suspended solids loadings averaged 10,000 pounds per day.

It is recommended that:

1. Facilities be provided capable of producing an effluent not to exceed:

    a. Suspended solids concentration of 35 mg/l

    b. Settleable solids concentration of 5 mg/l

2. The industry should begin investigations of satisfactory methods of disposing of chlorides and alternate methods of disposal of concentrated brine, such as subsurface disposal.

The above recommendations are made to prevent interference with navigation and fish and wildlife propagation and to protect municipal and industrial water supply.

American Agricultural Chemical Company

Waste treatment at this installation is considered satisfactory at this time, and no specific recommendations are made.

American Cement Corporation (Peerless Division)

Suspended solids, almost all of which are readily settleable, are present in excessive concentrations in the plant effluent. It is recommended that the effluent concentrations of suspended solids and settleable solids be limited to 35 mg/l and 5 mg/l, respectively.

The foregoing recommendation is made to prevent interference with navigation and fish and wildlife propagation.

Darling and Company

Survey reports indicate inadequate facilities for control of BOD and coliform organisms. This plant discharges to the Rouge, and subsequently to the Detroit River, wastes equivalent in oxygen-consuming capacity to the untreated wastes of over 40,000 persons.

It is recommended that:

Facilities be provided capable of producing an effluent not to exceed:

a. Monthly geometric mean coliform density of 5,000/100 ml

b. Biochemical oxygen demand of 20 mg/l

The above recommendations are made to protect municipal water supply and prevent interference with fish and wildlife propagation.

Ford Motor Company

Wastes from this plant represent, in volume, approximately 83 percent of the industrial wastes being discharged into the Rouge and subsequently into the Detroit River. Phenolic wastes exceed the limit of 600 pounds per day set by the Michigan Water Resources Commission. Concentrations of iron, phenols, and oil exceed 17 mg/l, 20 µg/l, and 15 mg/l, respectively. Suspended and especially settleable solids are excessive at times, while excellent control was achieved on other occassions. Acid discharged in the form of spent pickling liquor is excessive and imparts an unnatural color to the Rouge and Detroit Rivers.

Phenols, iron, and oil and grease from this industry constitute over 90 percent of the loading from industrial sources to the Rouge River. Improvement must be accomplished at this source if significant reduction in waste loadings to the Rouge River and subsequently to the Detroit River is to be effected.

It is recommended that:

1. Facilities be provided or existing facilities operated to produce an effluent not to exceed:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

c. Phenol concentration of 20 µg/l

d. Ammonia concentration of 2 mg/l

e. Iron concentration of 17 mg/l

2. Oil removal facilities be operated to limit the oil concentration in the effluent to 15 mg/l. In addition, the industry should investigate methods of further reduction in oil discharged in the plant effluent by in-plant control.

The above recommendations are made to prevent interference with municipal water supplies, recreational use of water, navigation, and fish and wildlife propagation.

Scott Paper Company

The effluent contains excessive quantities of suspended solids. Over 31,000 pounds of suspended solids per day are discharged to the Rouge and subsequently to the Detroit River. This industry discharges to the receiving stream wastes equivalent in oxygen-consuming capacity to the untreated sewage from a population of over 800,000 persons.

It is recommended that facilities be provided capable of producing an effluent not to exceed:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

c. Biochemical oxygen demand of 85 mg/l

This recommendation is made to prevent interference with navigation and fish and wildlife propagation.

Lower Detroit River

Chrysler Corporation (Amplex Division)

Pollution control is considered satisfactory at this time, and no specific recommendations for improvement are made.

Chrysler Corporation (Cycleweld Division)

Pollution control is considered satisfactory at this time, and no specific recommendations for improvement are made.

Chrysler Corporation (Engine Division)

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

Dana Corporation

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

E. I. du Pont de Nemours and Company (Industrial and Biochemical Division)

This company was found not to be in compliance with the restriction on pH set for it by the Michigan Water Resources Commission

Firestone Tire and Rubber Company

Excessive concentrations of iron were found in the plant effluent. Over 5,000 pounds per day of this substance were discharged to the Detroit River.

It is recommended that iron concentration in the effluent be reduced to levels not exceeding 17 mg/l.

The above recommendation is made to prevent interference with fish and wildlife propagation.

Fuel Oil Corporation

Excessive concentrations of oil were found in the effluent from this installation when ships were being washed. At these times the concentrations are over 300 mg/l.

No specific recommendations for improvement are made, since the Michigan Water Resources Commission has reported that this industry has recently suspended ship-washing operations. It is recommended not to permit resumption of such operations until controls are instituted to limit oil in the effluent to 15 mg/l.

Great Lakes Steel Corporation - Strip Mill

Excessive quantities of suspended solids and settleable solids are discharged to the Detroit River. Since the major portion of these suspended solids is readily settleable, it is recommended that the concentration of settleable solids be limited to 5 mg/l and the concentration of suspended solids to 35 mg/l. The Michigan Water Resources Commission reports excessive oil discharges, and controls should be instituted to limit effluent to conform with the Commission's order.

This recommendation is made to prevent interference with navigation and fish and wildlife propagation.

Great Lakes Steel Corporation - Ecorse

Excessive concentrations and significant quantities of oil, iron, suspended solids, settleable solids, and acid are discharged. Over 50 percent of the iron and acid loadings to the Detroit River originate here. Effluents containing acid wastes are far below pH 5.5, and these wastes are mainly responsible for lowering the Detroit River below pH 4.0 in the vicinity of the plant.

It is recommended that:

1. Acid wastes be controlled so that discharges fall within the range pH 5.5-10.6.

2. Facilities be provided or existing facilities operated to produce an effluent not to exceed:

a. Oil concentration of 15 mg/l

b. Suspended solids concentration of 35 mg/l

c. Settleable solids concentration of 5 mg/l

d. Iron concentration of 17 mg/l

The foregoing recommendations are made to prevent interference with municipal water supplies, recreational use of waters, navigation, and fish and wildlife propagation.

Koppers Company

Waste discharges from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

McLouth Steel Corporation - Gibraltar

Control of oil, iron, and suspended solids discharges at this plant is marginal, with improvement noted during the last months of study.

It is recommended that:

All waste treatment practices be reviewed and steps taken to improve the effluent to conform consistently to the Order of Determination issued by the Michigan Water Resources Commission.

McLouth Steel Corporation - Trenton

The waste treatment facilities of this installation have been very erratically operated from the standpoint of control of suspended solids, settleable solids, iron, phenols, oil, and pH. At times excellent treatment was achieved; at other times complete lack of treatment effectiveness was observed, with concentrations of solids, oil, phenols, and iron exceeding the Order of Determination of the Michigan Water Resources Commission.

Since it has been demonstrated that this industry can achieve effective pollution control by operation of its existing facilities, it is recommended that steps be taken to assure an effluent not to exceed:

a. Iron concentration of 17 mg/l

b. Suspended solids concentration of 35 mg/l

c. Settleable solids concentration of 5 mg/l

d. Oil concentration of 15 mg/l

Mobil Oil Company

During the survey the concentration of oil in the plant effluent was excessive, and additional grab samples before and after the survey indicated erratic operation. Effective operation of the industry's oil separation facilities should also improve suspended solids removal.

It is recommended that:

1. Existing facilities be operated effectively or additional facilities provided to assure an oil concentration in the effluent not to exceed 15 mg/l at all times.

2. Suspended solids and settleable solids in the effluent be maintained below 35 mg/l and 5 mg/l.

The above recommendations are made to prevent interference with fish and wildlife propagation.

Monsanto Chemical Corporation

Waste treatment at this installation is satisfactory with the exception of phosphate concentrations and loadings in the plant effluent. Over 10,000 pounds per day of phosphates are discharged into the Detroit River.

It is recommended that treatment be provided to reduce concentrations and loadings of phosphates by approximately 80%.

The above recommendation is made to prevent interference with fish and wildlife propagation, recreation, and municipal water supply.

Pennsalt Chemical Corporation - East Plant

The concentrations of chlorides, suspended solids, and settleable solids in the plant effluent were excessive. Approximately ½ million pounds of chlorides per day were discharged to the Detroit River, representing about 20 percent of the total chloride discharge to the River.

It is recommended that:

1. Treatment facilities be installed to reduce the suspended solids in the plant effluent not to exceed 35 mg/l and settleable solids to 5 mg/l.

2. The industry begin investigation of satisfactory methods for disposing of chlorides and alternate methods of disposal of concentrated brines, such as subsurface disposal.

The above recommendations are made to prevent interference with navigation and fish and wildlife propagation and to protect municipal and industrial water supply.

Pennsalt Chemical Corporation - West Plant

Wastes from this plant had excessive concentrations of phenols, suspended solids, and settleable solids. Phenol concentrations were found over 1,000 µg/l but no interference with existing water uses in the Detroit River or Michigan Lake Erie was apparent at this time.

It is recommended that:

1. The entire waste disposal program of this plant be carefully investigated by company personnel, since discharge of phenols, oxidizing agents, and settleable solids is far in excess of that expected by company officials.

2. Facilities be provided or existing facilities operated to produce an effluent not exceeding:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

The above recommendations are made to prevent interference with navigation and fish and wildlife propagation.

Shawinigan Resins Corporation and Monsanto Chemical Corporation (Saflex Division)

The wastes from these two plants are discharged to the Detroit River from a common lagoon. During the survey the only waste constituents considered excessive were BOD and suspended solids (originating primarily from Shawinigan Resins). The planned installation of a new lagoon after the survey should reduce these levels considerably; therefore no recommendations for improvement are made at this time.

Wyandotte Chemicals Corporation - North Plant

Concentrations of chlorides, suspended solids, and settleable solids in the plant effluent were excessive. The contribution of chlorides in the amount of 1,300,000 pounds per day represents almost half the entire industrial loading to the Detroit River. The suspended and settleable solids loadings from this industry represent 35 percent of the total loadings to the Detroit River from industrial sources.

The composition of the suspended solids (most of which are readily settleable) is mainly calcium carbonate. This chemical is only slightly soluble in water and will readily settle out in clarifiers. Sludge from this operation when discharged to the River will settle on the River and Lake bottom and interfere with aquatic life.

It is recommended that:

1. Facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

2. The industry continue investigation of satisfactory methods of disposing of chlorides, and alternate methods of disposal of concentrated brines, such as subsurface disposal.

These recommendations are made to prevent interference with navigation and fish and wildlife propagation and to protect municipal and industrial water supply.

Wyandotte Chemicals Corporation - South Plant

Heavily concentrated wastes are pumped from this plant to the waste beds of Fighting Island. The remainder of the plant effluent is discharged to the Detroit River and contains excessive concentrations of chlorides and suspended solids.

It is recommended that:

1. Facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

2. The industry continue investigation of satisfactory methods of disposing of chlorides and alternate methods of disposal of concentrated brines, such as subsurface disposal.

These recommendations are made to prevent interference with navigation and fish and wildlife propagation and to protect municipal and industrial water supply.

Wyandotte Chemicals Corporation - South Plant (Propylene Oxide)

Wastes discharged from this source were not found to interfere with existing water uses in the Detroit River or Michigan Lake Erie.

B. Lake Erie and Tributaries

The maintenance of adequate levels of dissolved oxygen in the lower Raisin River is the mutual responsibility of all discharging oxygen-demanding wastes into the River. Each recommendation made in this regard is to be understood as part of this mutual responsibility, and no industry or municipality is singly responsible for achieving the recommended DO level.

1. Municipal Waste Treatment

Monroe Sewage Treatment Plant

Two surveys revealed an influent fairly typical of a weak domestic waste. Exceptions to this general observation include high concentrations of soluble and total phosphates and certain toxic metals, including copper, zinc, and lead. These constituents were present in approximately the same concentrations in the plant effluent.

Plant efficiency, as measured by percent removal of suspended solids and BOD, was very good for a primary sewage treatment plant. Bacterial control was effective during the first survey when the effluent was chlorinated but poor during the second survey when it was not. Study of operating records revealed that similar degrees of plant efficiency were maintained on a long-term basis. The operation of this plant is considered outstanding for an installation of this type, and the operating personnel are commended.

It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be operated at levels capable of providing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml. during the months of April through November.

3. The current plan of separating roof runoff from sanitary wastes to prevent overloading plant facilities be accelerated.

The above recommendations are made to prevent interference with recreational use of water and fish and wildlife propagation.

2. Industrial Waste Treatment

Enrico Fermi Atomic Reactor

Waste treatment was found to be satisfactory, and no specific recommendations are made at this time.

Consolidated Paper Company - North Plant

Significant quantities of suspended solids, settleable solids, and BOD are discharged into the Raisin River and subsequently into Lake Erie. The wastes from this industry are equivalent in oxygen-consuming capacity to the untreated wastes from a population of over 100,000 persons, or approximately 45 percent of the total load to the Raisin River. Densities of coliform and fecal streptococcus organisms were also excessive.

It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

3. Facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

The above recommendations are made to prevent interference with recreational use of water, navigation, and fish and wildlife propagation.

Consolidated Paper Company - South Plant

Significant quantities and high concentrations of suspended solids, settleable solids, and BOD are discharged into the Raisin River and subsequently into Lake Erie. The wastes from this industry are equivalent in oxygen-consuming capacity to the untreated wastes of over 40,000 persons. Densities of coliform and fecal streptococcus organisms are unusually excessive, averaging over 1,000,000 total coliform organisms per 100 ml during the special survey.

It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

3. Facilities be provided capable of producing an effluent not to exceed:

   a. Suspended solids concentration of 35 mg/l

   b. Settleable solids concentration of 5 mg/l

The above recommendations are made to prevent interference with recreational use of water, navigation, and fish and wildlife propagation.

Ford Motor Company

The discharge from this plant represents 80 percent of the total waste volume from industrial sources discharged to the Raisin River and subsequently into Lake Erie. Cyanide concentrations and loadings in the plant effluent are excessive. The effluent from the company-owned sewage treatment plant is not chlorinated. The quantity of oil released to the Raisin River through a dilution canal outlet is excessive even though the concentration remains below 15 mg/l.

It is recommended that:

1. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November

2. Treatment facilities be operated to limit the cyanide concentration in the plant effluent to 0.025 mg/l.

3. Oil removal facilities be provided to limit the concentrations of oil reaching the dilution canal from in-plant sources to 15 mg/l.

The foregoing recommendations are made to prevent interference with recreational use of water and fish and wildlife propagation.

Monroe Auto Equipment Company

Waste treatment at this installation is considered satisfactory at this time, and no specific recommendations for improvement are made.

Monroe Paper Products Company

Significant quantities and high concentrations of suspended solids, settleable solids, and BOD are discharged from this source into the Raisin River and subsequently into Lake Erie. The major portion of the suspended solids is readily settleable. Densities of coliform organisms were found to be excessive during the first survey at 32,400 organisms per 100 ml; however, during a separate Public Health Service survey several months later, the average coliform concentration exceeded 2,000,000 organisms per 100 ml.

It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the months of April through November.

3. Facilities be provided capable of producing an effluent not to exceed:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

The above recommendations are made to prevent interference with recreational use of water, navigation, and fish and wildlife propagation.

Union Bag-Camp Paper Company
River Raisin Division

Significant quantities and high concentrations of suspended solids, settleable solids, and BOD are discharged from this installation to the Raisin River and subsequently into Lake Erie. The wastes from this industry are equivalent in oxygen-consuming capacity to the untreated wastes of 70,000 persons. A large part of the suspended solids was readily settleable.

It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5,000 organisms per 100 ml during the month of April through November.

3. Facilities be provided capable of producing an effluent not exceeding:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

The above recommendations are made to prevent interference with recreational use of water, navigation, and fish and wildlife propagation.

C. Special Problems

I. Overflows from Combined Sewers

Although the severe effect of overflows from combined sewers upon water quality in the Detroit River and limited areas of Michigan Lake Erie was demonstrated, a specific method of approach to the solution of this problem is not now evident.

It is recommended to the Michigan Water Resources Commission that it require a detailed engineering study be made to determine costs and select an effective method of control. It is also recommended that a report of these investigations, containing the method to be used to solve this problem and a time schedule for accomplishment, be submitted within two years to the Secretary of Health, Education, and Welfare.

It is further recommended that agencies responsible for the current operation of combined sewer systems in the Detroit area immediately take steps to lessen the pollutional effects of malfunctioning overflow regulators by finding and correcting the cause of failure of these diversion devices and checking the operation of all overflows every day to determine if unnecessary overflows are occurring.

2. Federal Installations

U. S. Naval Air Station, Grosse Ile, Michigan

It is recommended that:

1. A separator capable of producing an effluent containing less than 15 mg/l oil be installed on the line receiving aircraft washing wastes.

2. Operation of existing sewage treatment facilities be improved by performing such procedures as breaking up scum in gas vents, reversal of flow at periodic intervals, more frequent withdrawal of sludge, and daily scraping of the sides of the sedimentation chamber.

3. Better operation records be maintained.

4. Continuous and effective chlorination of plant effluent be practiced to assure that the geometric mean coliform density does not exceed 2,400 organisms per 100 ml.

5. The outmoded septic tank installation at the boat dock be replaced with an aerobic digestion treatment unit providing primary and secondary treatment followed by chlorination of the effluent.

6. If the U. S. Naval Air Station does not close on or before September 1, 1967, as scheduled, one of two alternatives be followed:

a. Connection to the municipal sewage collection and treatment system proposed for construction at Grosse Ile.

b. Enlargement of the present naval facilities to include secondary treatment as proposed in the original plans.

At this writing the Navy has agreed to all of the foregoing recommendations and has already taken steps to accomplish all but the last recommendation.

U. S. Coast Guard Station - Detroit River Light

It is recommended that a macerator-chlorination type treatment unit similar to those placed aboard motor launches be installed to the sanitary waste line now discharging raw sewage into Lake Erie.

U. S. Corps of Engineers Dredging Operations

It is recommended that:

1. The hopper dredges discontinue disposing of the ship's trash and garbage at the Raisin River dumping grounds.

2. Suitable treatment units be installed aboard ship to adequately dispose of all sanitary wastes including trash, garbage, and human excreta.

3. Closer control be exercised to minimize the loss of dredge material from the hoppers while proceeding to the dumping grounds.

4. A vigorous attempt be made by the Corps of Engineers to reduce the amount of dredging with action leading to reduction of discharge of settleable material by increasing the charges to polluters for removing the material commensurate with the damages to water uses incurred. (It is believed that it was not the intent of Congress that such dredging operations should provide a method of disposal of solid material deposited by individuals or corporations in navigable streams.) It is desirable not only that dredged channels be maintained but that every means possible be taken to keep the cost of such maintenance to a minimum.

The District Engineer has agreed to take steps to see that the recommendations are put into effect. He reiterated that the Corps of Engineers does charge the polluters for removing the material commensurate with the damages to water uses incurred and that the Corps of Engineers does not have any statutory authority to prevent the original discharge of the material to the navigable waterway. He also stressed the responsibility of the Corps of Engineers in enforcing Federal legislation relative to discharge of waste materials from vessels into navigable waters.

3. Sterling State Park

These recommendations repeat those already given for specific areas; they are listed here to emphasize what is necessary to abate water pollution at Sterling State Park.

A. The Consolidated Paper Company, Union Bag-Camp Paper Company, and Monroe Paper Products Company. It is recommended that:

1. Treatment be provided, capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5000 organisms per 100 ml during the months of April through November.

3. Facilities be provided capable of producing an effluent not to exceed:

a. Suspended solids concentration of 35 mg/l

b. Settleable solids concentration of 5 mg/l

B. The Ford Motor Company. It is recommended that:

1. Bacterial reduction facilities be provided and operated at levels capable of producing an effluent with a monthly geometric mean coliform density of less than 5000 organisms per 100 ml during the months of April through November.

2. Treatment facilities be operated to limit the cyanide concentration in the plant effluent to 0.025 mg/l.

3. Oil removal facilities be provided to limit the concentration of oil reaching the dilution canal from in-plant sources to 15 mg/l.

C. The City of Monroe. It is recommended that:

1. Treatment be provided capable of assuring a minimum dissolved oxygen concentration in the Raisin River below this source of 3 mg/l. Any plan for achieving this goal should include secondary treatment as a minimum.

2. Bacterial reduction facilities be operated at levels capable of providing an effluent with a monthly geometric mean coliform density of less than 5000 organisms per 100 ml during the months of April through November.

3. The current plan of separating roof runoff from sanitary wastes to prevent overloading plant facilities be accelerated.

D. In the area north of Sterling State Park between Sandy Creek and Stony Creek, it is recommended that measures be taken to eliminate direct and indirect discharge of sanitary sewage to Lake Erie. It is also recommended that discharge of sanitary wastes to the storm pumping stations be eliminated.

E. Septic tanks tend to function poorly due to the nature of the soil and the high water table. It is recommended that shorefront communities having septic tanks and direct discharge installations be sewered and the wastes transported to a sewage treatment plant providing adequate treatment and chlorination.

F. It is recommended that the practice of allowing discharge of raw and septic tank effluent from the suburban area outside Monroe to surface drains be discontinued. This material is discharged into the Raisin River during heavy rainfall. It is further recommended that the area be sewered with sanitary wastes transported to a sewage treatment plant providing adequate treatment and chlorination.

The foregoing recommendations are listed in the order of greatest importance to improving water quality at the Sterling State Park.

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